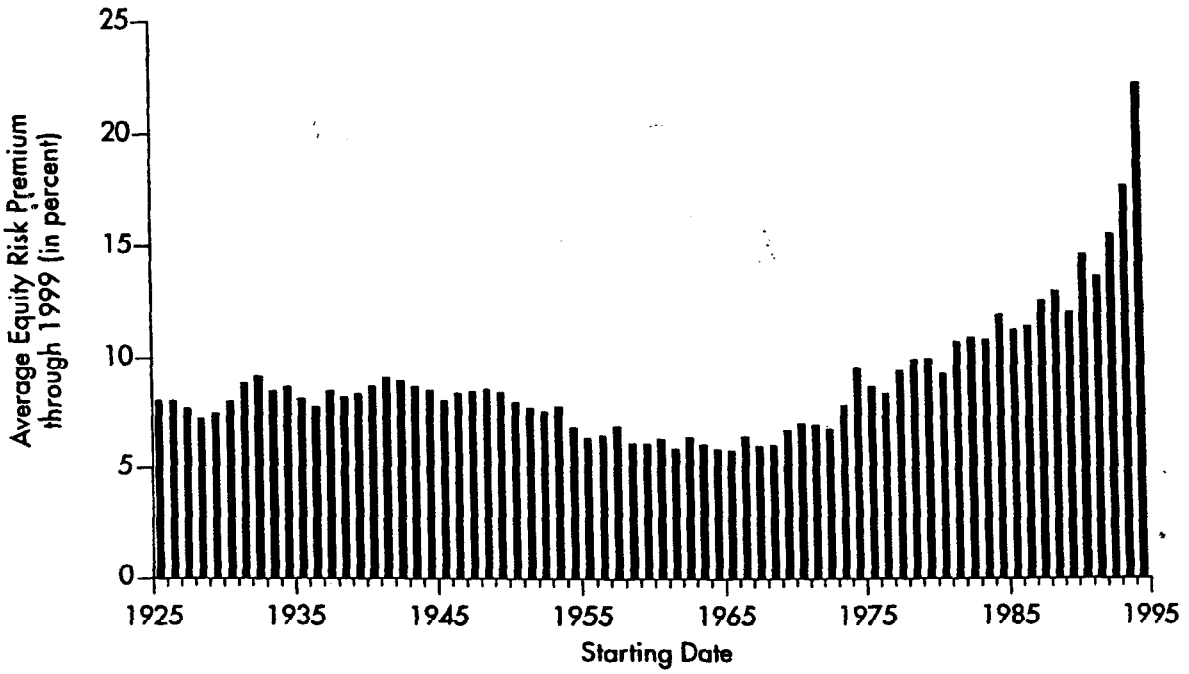
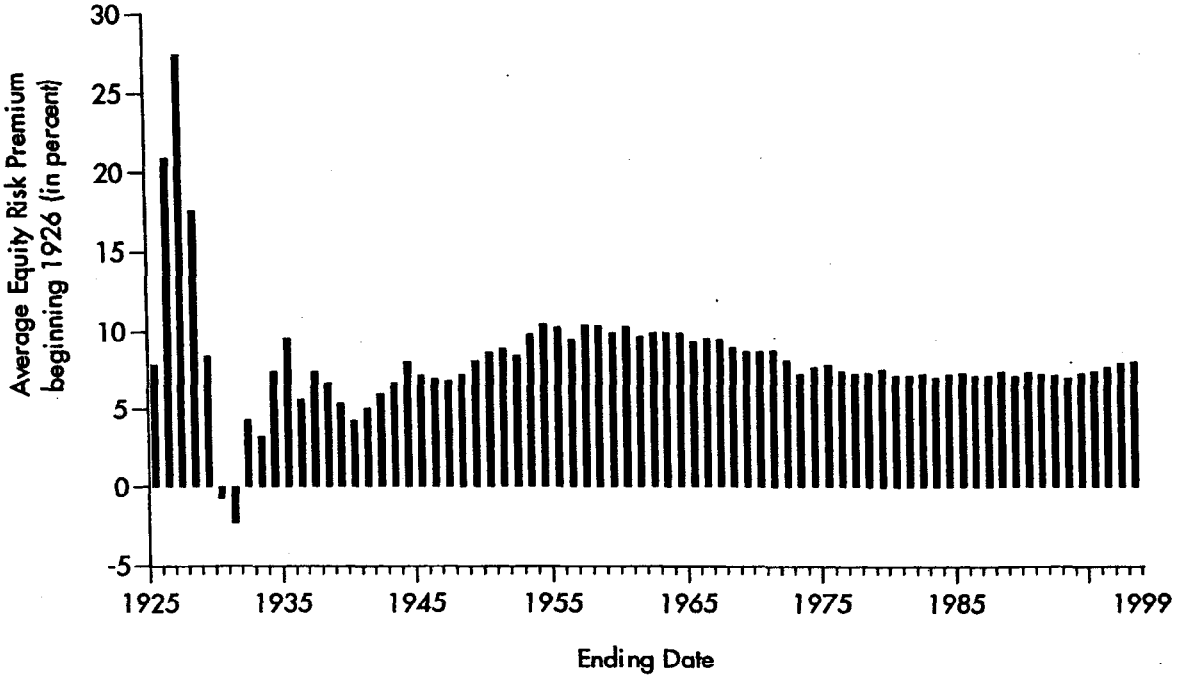
Graph 3-5: Equity Risk Premium Using Different Starting Dates (1926–1999)



Additionally, use of recent historical periods for estimation purposes can lead to illogical conclusions. As seen in Table 3-5, the recent bull market has caused the realized equity risk premium in the shorter historical periods to be much higher than the long-term average.

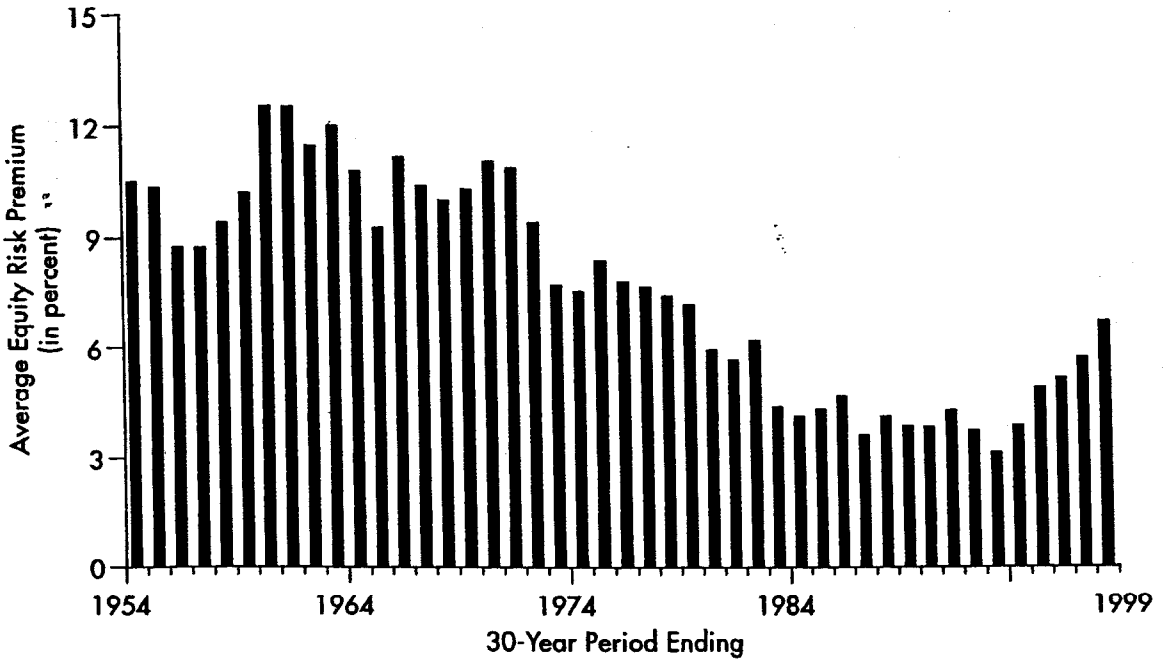
The impact of adding one additional year of data to a historical average is lessened the greater the initial time period of measurement. Short-term averages can be affected considerably by one or more unique observations. On the other hand, long-term averages produce more stable results. A series of graphs looking at the realized equity risk premium will illustrate this effect. Graph 3-6 shows the average (arithmetic mean) realized long-horizon equity risk premium starting in 1926. Each additional point on the graph represents the addition of another year to the average. Although the graph is extremely volatile in the beginning periods, the stability of the long-term average is quite remarkable. Again, the "unique" periods of time will not be weighted heavily in a long-term average, resulting in a more stable estimate.

Graph 3-6: Equity Risk Premium Using Different End Dates (1926–1999)



Some practitioners argue for a shorter historical time period, such as 30 years, as a basis for the equity risk premium estimation. The logic for the use of a shorter period is that historical events and economic scenarios present before this time are unlikely to be repeated. Graph 3-7 shows the equity risk premium measured over 30-year periods, and it appears from the graph that the premium has been trending downwards. The 30-year equity risk premium remained close to 4 percent for several years in the 1980s and 1990s but started to increase in the most recent 30-year periods.

Graph 3-7: Equity Risk Premium Over 30-Year Periods (1926–1999)



The key to understanding this result lies again in the years 1973 and 1974. The oil embargo during this period had a tremendous effect on the market. The equity risk premium for these years alone was –21 and –34 percent, respectively. If we look at the last 30 years excluding 1973 and 1974, the 28-year period results in an equity risk premium of 9.2 percent, as opposed to 6.7 percent with these years included.

The effect of the 1973–1974 period is even more pronounced when looking at the equity risk premium over 20-year periods, as seen in Graph 3-8. Using the 20-year historical average equity risk premium results in a very unstable estimate. Periods that include the years 1973 and 1974 result in an average equity risk premium as low as 2.0 percent. In the more recent 20-year periods that exclude 1973 and 1974, the average rises dramatically to over 8.0 percent. It is difficult to justify such a large divergence in estimates of return over such a short period of time. This does not suggest, however, that the years 1973 and 1974 should be excluded from any estimate of the equity risk premium; rather, it emphasizes the importance of using a long historical period when measuring the equity risk premium in order to obtain a reliable average that is not overly influenced by short-term returns.

REGULATORY FINANCE:

UTILITIES' COST OF CAPITAL

Roger A. Morin, PhD

in collaboration with
Lisa Todd Hillman

1994
PUBLIC UTILITIES REPORTS, INC.
Arlington, Virginia

TABLE OF CONTENTS

Schedule 8

Consumers Illinois Water Company
Value Line Adjusted Betas for the
Mr. McNally's Water Utility Sample and
Mr. McNally's Comparable Sample

	Value Line Adjusted Beta
Mr. McNally's Water Utility Sample	
American States Water Company	0.65
American Water Works Co., Inc.	0.55
Artesian Resources	NA
Connecticut Water Service, Inc.	NA
Middlesex Water Company	NA
Pennichuck Corporation	NA
Philadelphia Suburban Corp.	0.55
Mr. McNally's Comparable Sample	
Connecticut Water Service, Inc.	NA
Constellation Energy Corp.	0.50
Hawaiian Electric Industries, Inc.	0.50
IdaCorp, Inc.	0.50
Kansas City Power and Light Co.	0.60
Northwest Natural Gas Co.	0.60
Pennichuck Corp.	NA
Philadelphia Suburban Corp.	0.55
Potomac Electric Power Co.	0.50
Public Service Enterpises Group	0.55
RGS Energy Group, Inc.	0.55

Source of Information: Value Line Investment Survey,
June 23, July 7, August 4, August 18, and
September 8, 2000, Standard Edition

Fundamentals of Financial Management

Fifth Edition

Eugene F. Brigham
University of Florida

The Dryden Press
Chicago Fort Worth San Francisco Philadelphia Montreal Toronto London Sydney Tokyo

Costs of Capital for Projects of Differing Riskiness. As noted in Chapter 11, care must be taken to assign different risk-adjusted discount rates to capital budgeting projects of differing degrees of riskiness.

Capital Structure Weights. In this chapter we have simply taken as given the target capital structure and used this target to obtain the weights used to calculate k. As we shall see in Chapter 17, establishing the target capital structure is a major task in itself.

Dynamic Considerations. Capital budgeting and cost of capital estimates are a part of the *planning process* — they deal with ex ante, or estimated, data rather than ex post, or historical data. Hence, we can be wrong about the location of the IOS and the MCC. For example, we can underestimate the MCC and hence accept projects that, with 20-20 hindsight, we should have rejected. In a dynamic, changing world this is a real problem. Interest rates and money costs could be low at the time plans are being laid and contracts to build plants are being let, but six or eight months later these capital costs could have risen substantially. Thus, a project that formerly looked good could turn out to be a bad one because we improperly forecasted the MCC schedule.

Although this listing of problem areas may appear formidable, the state of the art in cost of capital estimation is really not in bad shape. The procedures outlined in this chapter can be used to obtain cost of capital estimates that are sufficiently accurate for practical purposes, and the problems listed here merely indicate the desirability of certain refinements. The refinements are not unimportant, but the problems we have identified do not invalidate the usefulness of the procedures outlined in the chapter.

Small Business

COST OF EQUITY CAPITAL FOR SMALL FIRMS

The three equity cost estimating techniques that were discussed in this chapter have serious limitations when applied to small firms, thus increasing the need for the small-business manager to use judgment. Consider first the constant growth model, $k_s = D_1/P_0 + g$. Imagine a small, rapidly growing firm, such as Bio-Technology General (BTG), which does not now and will not in the foreseeable future pay dividends. For firms like this, the constant growth model is simply not applicable. In fact, it is difficult to imagine any dividend model that would be of practical benefit for such a firm because of the difficulty of estimating growth rates.

The method which calls for adding a risk premium of about 3 percent to the firm's cost of debt can be used for some small firms, but problems arise if the firm does not have a fixed rate issue outstanding. BTG, for example, has no such debt issue outstanding, so we could not use the bond-yield-plus-risk-premium approach for BTG.

The third approach, the CAPM, is also often unusable because if the firm's stock is not publicly

traded, then we cannot calculate the firm's beta. For the privately owned firm, we might use the so-called "pure play" CAPM technique. This involves finding a firm in the same line of business that does have public equity, estimating its beta, and then using this beta as a proxy for that of the small business in question.

To illustrate the pure play approach, again consider BTG. The firm is not publicly traded, so we cannot estimate its beta. However, data are available on more established firms, such as Genentech and Genetic Industries, so we could use their betas as representative of the biological and genetic engineering industry. Of course, these firms' betas would have to be subjectively modified to reflect their larger sizes and more established positions, as well as to take account of the differences in the nature of their products and their capital structures as compared to those of BTG. Still, as long as there are public companies in similar lines of business available for comparison, the estimates of their betas can be used to help estimate the cost of capital of a firm whose equity is not publicly traded. Note that a "liquidity premium" as discussed in Chapter 3 would also have to be added to reflect the illiquidity of the small, nonpublic firm's stock.

Flotation Costs for Small Issues

When external equity capital is raised, flotation costs increase the cost of equity capital beyond what it would be for internal funds. These external flotation costs are especially significant for smaller firms, and they can substantially affect capital budgeting decisions involving external equity funds. To illustrate this point, consider a firm that is expected to pay constant dividends forever, and hence whose growth rate is zero. In this case, if F is the percentage flotation cost, then the cost of equity capital is $k_e = D_1/[P_0(1 - F)]$. The higher the flotation cost, the higher the cost of external equity.

How big is F? According to the latest Securities and Exchange Commission data, the average flotation cost of large common stock offerings (more than $50 million) is only about 4 percent. For a firm that is expected to provide a 15 percent dividend yield (that is, $D_1/P_0 = 15\%$), the cost of equity is 15%/(1 − 0.04), or 15.6 percent. However, the SEC's data on small stock offerings (less than $1 million) show that flotation costs for such issues average about 21 percent. Thus, the cost of equity capital in the preceding example would be 15%/(1 − 0.21), or about 19 percent. When we compare this to the 15.6 percent for large offerings, it is clear that a small firm would have to earn considerably more on the same project than a large firm. Small firms are therefore at a substantial disadvantage because of the effects of flotation costs.

The Small-Firm Effect

A number of researchers have observed that portfolios of small-firm stocks have earned consistently higher average returns than those of large-firm stocks; this is called the "small-firm effect." On the surface, it would seem to be advantageous to the small firm to provide average returns in the stock market that are higher than those of large firms. In reality, it is bad news for the small firm; what the small-firm effect means is that the capital market demands higher returns on stocks of small firms than on otherwise similar stocks of large firms. Therefore, the cost of equity capital is higher for small firms. This compounds the high flotation cost problem noted above.

It may be argued that stocks of small firms are riskier than those of large ones and that this accounts for the differences in returns. It is true that academic research usually finds that betas are higher on average for small firms than for large ones. However, the larger returns for small firms remain larger even after adjusting for the effects of their higher risks as reflected in their beta coefficients.

The small-firm effect is an anomaly in the sense that it is not consistent with the CAPM theory. Still, higher returns reflect a higher cost of capital, so we must conclude that smaller firms do have higher capital costs than otherwise similar larger firms. The manager of a small firm should take this factor into account when estimating his or her firm's cost of equity capital. In general, the cost of equity capital appears to be about four percentage points higher for small firms (those with market values of less than $20 million) than for large, New York Stock Exchange firms with similar risk characteristics.

STOCKS, BONDS, BILLS AND INFLATION:

2000 YEARBOOK

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Chapter 5 Firm Size and Return

The Firm Size Phenomenon

One of the most remarkable discoveries of modern finance is that of a relationship between firm size and return. The relationship cuts across the entire size spectrum but is most evident among smaller companies, which have higher returns on average than larger ones. Many studies have looked at the effect of firm size on return.[1] In this chapter, the returns across the entire range of firm size are examined.

Construction of the Decile Portfolios

The portfolios used in this chapter are those created by the Center for Research in Security Prices (CRSP) at the University of Chicago's Graduate School of Business. CRSP has refined the methodology of creating size-based portfolios and has applied this methodology to the entire universe of NYSE-listed securities going back to 1926.

The New York Stock Exchange universe excludes closed-end mutual funds, real estate investment trusts, foreign stocks, American Depository Receipts, unit investment trusts, and Americus Trusts. All companies on the NYSE are ranked by the combined market capitalization of their eligible equity securities. The companies are then split into 10 equally populated groups, or deciles. The portfolios are rebalanced, using closing prices for the last trading day of March, June, September, and December. Securities added during the quarter are assigned to the appropriate portfolio when two consecutive month-end prices are available. If the final NYSE price of a security that becomes delisted is a month-end price, then that month's return is included in the quarterly return of the security's portfolio. When a month-end NYSE price is missing, the month-end value of the security is derived from merger terms, quotations on regional exchanges, and other sources. If a month-end value still is not determined, the last available daily price is used.

Base security returns are monthly holding period returns. All distributions are added to the month-end prices, and appropriate price adjustments are made to account for stock splits and dividends. The return on a portfolio for one month is calculated as the weighted average of the returns for its individual stocks. Annual portfolio returns are calculated by compounding the monthly portfolio returns.

[1] Rolf W. Banz was the first to document this phenomenon. See Banz, Rolf W. "The Relationship Between Returns and Market Value of Common Stocks," *Journal of Financial Economics*, Vol. 9, 1981, pp. 3–18.

Size of the Deciles

Table 5-1 reveals that the top three deciles of the NYSE account for most of the total market value of its stocks. Approximately two-thirds of the market value is represented by the first decile, which currently consists of 186 stocks, while the smallest decile accounts for less than one-quarter of one percent of the market value. The data in the second column of Table 5-1 are averages across all 74 years. Of course, the proportion of market value represented by the various deciles varies from year to year.

Columns three and four give recent figures on the number of companies and their market capitalization, presenting a snapshot of the structure of the deciles near the end of 1999. It is important to note that these proportions are not representative of the American Stock Exchange (AMEX) or the over-the-counter (OTC) market. Small firms, as defined by NYSE rankings, make up far higher proportions of value in the AMEX and OTC markets. The aggregate market value of small firms in the AMEX and OTC markets is thus much larger than the corresponding value on the NYSE.

Table 5-1: Size-Decile Portfolios of the NYSE, Size and Composition (1926-1999)

Decile	Historical Average Percentage of Total Capitalization	Recent Number of Companies	Recent Decile Market Capitalization (in thousands)	Recent Percentage of Total Capitalization
1-Largest	65.27%	186	$7,537,187,053	76.27%
2	14.45%	182	1,115,150,718	11.28%
3	7.61%	185	497,727,909	5.04%
4	4.59%	183	274,796,124	2.78%
5	3.00%	185	174,953,833	1.77%
6	2.02%	183	118,014,701	1.19%
7	1.37%	184	78,066,231	0.79%
8	0.90%	184	50,129,702	0.51%
9	0.55%	184	26,506,709	0.27%
10-Smallest	0.25%	185	9,297,279	0.09%
Mid-Cap 3–5	15.19%	553	947,477,866	9.59%
Low-Cap 6–8	4.29%	551	246,210,634	2.49%
Micro-Cap 9–10	0.80%	369	35,803,988	0.36%

Source: Center for Research in Security Prices, University of Chicago.

Historical average percentage of total capitalization shows the average, over the last 74 years, of the decile market values as a percentage of the total NYSE calculated each year. Number of companies in deciles, recent market capitalization of deciles, and recent percentage of total capitalization are as of September 30, 1999.

Table 5-2 gives the current breakpoints that define the composition of the NYSE size deciles. The largest company and its market capitalization are presented for each decile. Table 5-3 shows the historical breakpoints for each of the three size groupings presented throughout this chapter. Mid-cap stocks are defined here as the aggregate of deciles 3–5. Based on the most recent data (Table 5-2), companies within this mid-cap range have market capitalizations at or below $4,221,601,000 but greater than $872,220,000. Low-cap stocks include deciles 6–8 and currently include all companies in the NYSE with market capitalizations at or below $872,220,000 but greater than $214,640,000. Micro-cap stocks include deciles 9–10 and include companies with market capitalizations at or below $214,640,000. The market capitalization of the smallest company included in the micro-capitalization group is currently $4.9 million.

Table 5-2: Size-Decile Portfolios of the NYSE, Largest Company and Its Market Capitalization by Decile (September 30, 1999)

Decile	Market Capitalization of Largest Company (in thousands)	Company Name
1-Largest	$369,722,214	General Electric Co.
2	10,498,796	Unisys Corp.
3	4,221,601	Reader's Digest Association Inc.
4	2,203,671	Sterling Software Inc.
5	1,304,131	Steris Corp.
6	872,220	Unova Inc.
7	577,778	Trammell Crow Co.
8	381,830	Transaction Network Services Inc.
9	214,640	Donna Karan International Inc.
10-Smallest	97,914	Delta Financial Corp.

Source: Center for Research in Security Prices, University of Chicago.

Table 5-3 **Size-Decile Portfolios of the NYSE** Largest and Smallest Company by Size Group (1926–1970)

Date (Sept 30)	Capitalization of Largest Company (in thousands)			Capitalization of Smallest Company (in thousands)		
	Mid-Cap 3-5	Low-Cap 6-8	Micro-Cap 9-10	Mid-Cap 3-5	Low-Cap 6-8	Micro-Cap 9-10
1926	$61,490	$14,040	$4,305	$14,100	$4,325	$43
1927	$65,281	$14,746	$4,450	$15,311	$4,496	$72
1928	$81,998	$18,975	$5,074	$19,050	$5,119	$135
1929	$107,085	$24,328	$5,875	$24,480	$5,915	$126
1930	$67,808	$13,050	$3,219	$13,068	$3,264	$30
1931	$42,607	$8,142	$1,905	$8,222	$1,927	$15
1932	$12,431	$2,170	$473	$2,196	$477	$19
1933	$40,298	$7,210	$1,830	$7,280	$1,875	$100
1934	$38,129	$6,669	$1,669	$6,734	$1,673	$68
1935	$37,631	$6,519	$1,350	$6,549	$1,383	$38
1936	$46,920	$11,505	$2,660	$11,526	$2,668	$98
1937	$51,750	$13,601	$3,500	$13,635	$3,539	$68
1938	$36,102	$8,325	$2,125	$8,372	$2,145	$60
1939	$35,784	$7,367	$1,697	$7,389	$1,800	$75
1940	$31,050	$7,990	$1,861	$8,007	$1,872	$51
1941	$31,744	$8,316	$2,086	$8,336	$2,087	$72
1942	$26,135	$6,870	$1,779	$6,875	$1,788	$82
1943	$43,218	$11,475	$3,847	$11,480	$3,903	$395
1944	$46,621	$13,066	$4,800	$13,068	$4,812	$309
1945	$55,268	$17,325	$6,413	$17,575	$6,428	$225
1946	$79,158	$24,192	$10,013	$24,199	$10,051	$829
1947	$57,830	$17,735	$6,373	$17,872	$6,380	$747
1948	$67,238	$19,575	$7,313	$19,651	$7,329	$784
1949	$55,506	$14,549	$5,037	$14,577	$5,108	$379
1950	$65,881	$18,675	$6,176	$18,750	$6,201	$303
1951	$82,517	$22,750	$7,567	$22,860	$7,598	$668
1952	$97,936	$25,452	$8,428	$25,532	$8,480	$480
1953	$98,595	$25,374	$8,156	$25,395	$8,168	$459
1954	$125,834	$29,645	$8,484	$29,707	$8,488	$463
1955	$170,829	$41,445	$12,353	$41,681	$12,366	$553
1956	$183,434	$46,805	$13,481	$46,886	$13,524	$1,122
1957	$192,861	$47,658	$13,844	$48,509	$13,848	$925
1958	$195,083	$46,774	$13,789	$46,871	$13,816	$550
1959	$253,644	$64,221	$19,500	$64,372	$19,548	$1,804
1960	$246,202	$61,485	$19,344	$61,529	$19,385	$831
1961	$296,261	$79,058	$23,562	$79,422	$23,613	$2,455
1962	$250,433	$58,866	$18,952	$59,143	$18,968	$1,018
1963	$308,438	$71,846	$23,819	$71,971	$23,822	$2,111
1964	$344,033	$79,343	$25,594	$79,508	$25,595	$1,974
1965	$363,759	$84,479	$28,365	$84,600	$28,483	$2,237
1966	$399,455	$99,578	$34,884	$99,935	$34,966	$4,218
1967	$459,170	$117,985	$42,267	$118,329	$42,313	$5,946
1968	$528,326	$149,261	$60,351	$150,128	$60,397	$9,471
1969	$517,452	$144,770	$54,273	$145,684	$54,353	$9,255
1970	$380,246	$94,025	$29,910	$94,047	$29,916	$4,749

Source: Center for Research in Security Prices, University of Chicago.

Table 5-3 **Size-Decile Portfolios of the NYSE** Largest and Smallest Company by Size Group (1971–1999)

(continued)

Date (Sept 30)	Capitalization of Largest Company (in thousands) Mid-Cap 3-5	Low-Cap 6-8	Micro-Cap 9-10	Capitalization of Smallest Company (in thousands) Mid-Cap 3-5	Low-Cap 6-8	Micro-Cap 9-10
1971	$542,517	$145,310	$45,571	$145,340	$45,687	$4,631
1972	$545,211	$138,938	$46,728	$139,647	$47,243	$3,150
1973	$424,584	$94,809	$29,731	$95,378	$29,832	$2,188
1974	$344,013	$75,272	$22,475	$75,853	$22,624	$1,925
1975	$465,763	$96,954	$28,140	$97,266	$28,144	$1,537
1976	$551,071	$116,184	$31,987	$116,212	$32,002	$1,537
1977	$573,084	$135,804	$39,192	$137,323	$39,254	$865
1978	$572,967	$159,778	$46,621	$160,524	$46,629	$3,951
1979	$661,336	$174,480	$49,088	$174,517	$49,246	$4,477
1980	$754,562	$194,012	$48,671	$194,241	$49,434	$3,701
1981	$954,665	$259,028	$71,276	$261,059	$71,289	$4,761
1982	$762,028	$205,590	$54,675	$208,111	$54,883	$3,211
1983	$1,200,680	$352,698	$103,443	$352,944	$103,530	$8,522
1984	$1,068,972	$314,650	$90,419	$315,214	$91,004	$2,964
1985	$1,432,342	$367,413	$93,810	$370,004	$94,794	$3,303
1986	$1,857,621	$444,827	$109,956	$449,015	$110,397	$4,021
1987	$2,059,143	$467,430	$112,035	$468,948	$113,419	$2,237
1988	$1,957,926	$420,257	$94,268	$421,340	$94,410	$1,507
1989	$2,145,947	$479,473	$99,903	$480,975	$99,963	$967
1990	$2,164,185	$472,003	$93,627	$474,065	$93,750	$132
1991	$2,129,863	$457,958	$87,586	$458,853	$87,978	$696
1992	$2,436,968	$501,428	$103,352	$501,599	$103,500	$941
1993	$2,711,068	$613,033	$137,945	$616,573	$138,823	$698
1994	$2,497,073	$601,552	$149,435	$602,552	$149,532	$598
1995	$2,790,122	$649,910	$158,063	$651,276	$158,292	$89
1996	$3,150,685	$760,022	$195,411	$763,377	$195,628	$2,579
1997	$3,511,132	$817,089	$230,472	$818,019	$230,685	$2,644
1998	$4,119,948	$918,323	$252,109	$923,552	$252,491	$2,427
1999	$4,221,601	$872,220	$214,640	$873,650	$218,102	$4,920

Source: Center for Research in Security Prices, University of Chicago.

Presentation of the Decile Data

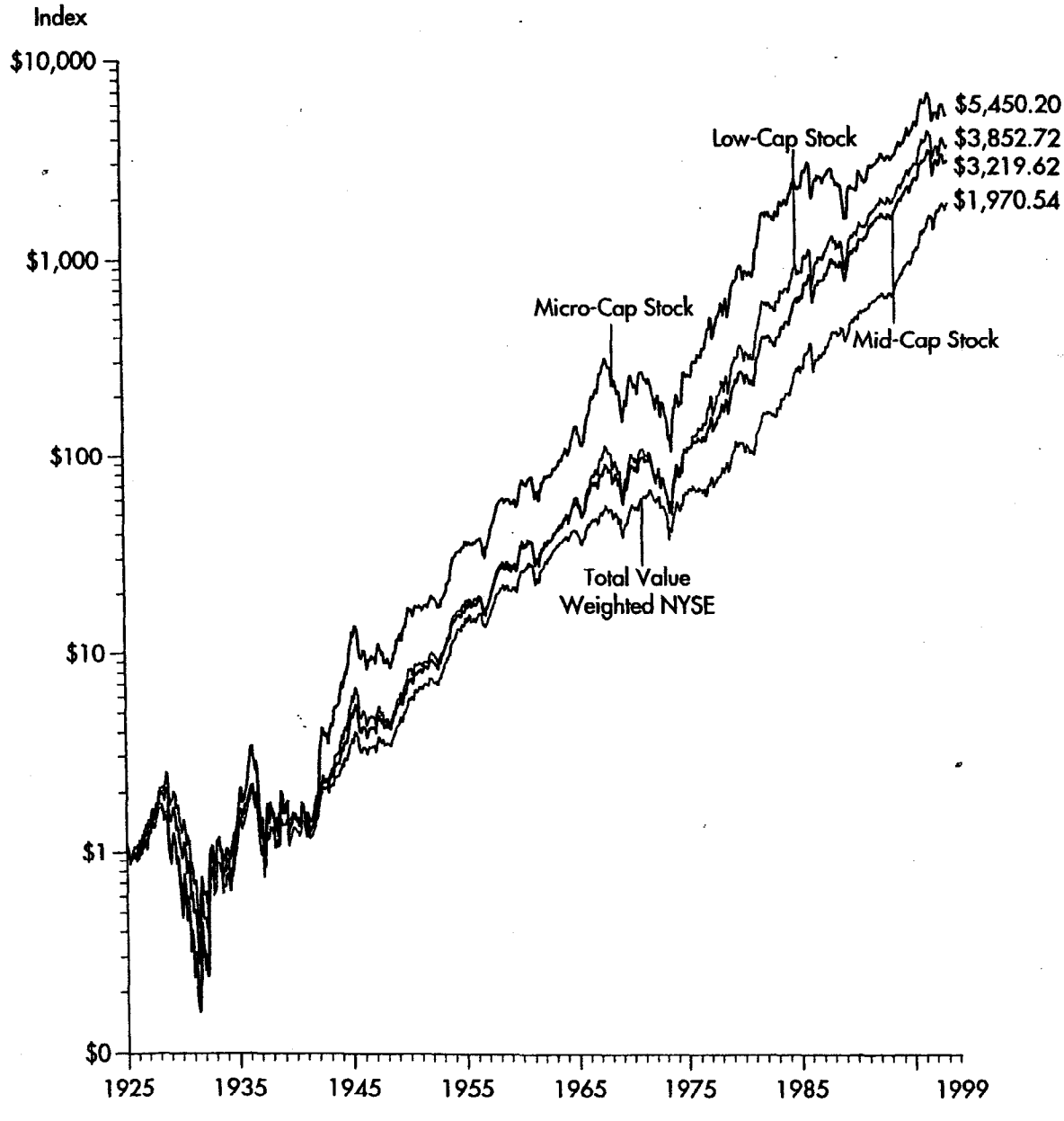
Summary statistics of annual returns of the 10 deciles over 1926–1999 are presented in Table 5-4. Note from this exhibit that both the average return and the total risk, or standard deviation of annual returns, tend to increase as one moves from the largest decile to the smallest. Furthermore, the serial correlations of returns are near zero for all but the smallest three deciles. Serial correlations and their significance will be discussed in detail later in this chapter.

Graph 5-1 depicts the growth of one dollar invested in each of three NYSE groups broken down into mid-cap, low-cap, and micro-cap stocks. The index values of the entire NYSE are also included. All returns presented are value weighted based on the market capitalizations of the deciles contained in each subgroup. The sheer magnitude of the size effect in some years is noteworthy. While the largest stocks actually declined in 1977, the smallest stocks rose more than 15 percent. A more extreme case occurred in the depression-recovery year of 1933, when the difference between the first and tenth decile returns was far more substantial. This divergence in the performance of small and large company stocks is a common occurrence.

Table 5-4: Size-Decile Portfolios of the NYSE, Summary Statistics of Annual Returns (1926–1999)

Decile	Geometric Mean	Arithmetic Mean	Standard Deviation	Serial Correlation
1-Largest	10.4%	12.1%	18.8	0.05
2	11.2	13.6	22.0	0.03
3	11.4	13.9	23.8	–0.01
4	11.5	14.6	26.3	–0.00
5	11.9	15.3	27.1	–0.00
6	11.8	15.4	28.1	0.07
7	11.6	15.7	30.4	0.04
8	11.9	16.8	34.2	0.10
9	12.0	17.6	36.8	0.10
10-Smallest	12.9	20.7	45.6	0.18
Mid-Cap, 3–5	11.5	14.3	25.0	–0.01
Low-Cap, 6–8	11.8	15.8	29.8	0.07
Micro-Cap, 9–10	12.3	18.4	39.0	0.12
NYSE Total Value-Weighted Index	10.8	12.7	19.9	0.02

Graph 5-1: Size-Decile Portfolios of the NYSE: Wealth Indices of Investments in Mid-, Low-, Micro- and Total Capitalization Stocks (1925–1999)*



*Year-end 1925 = $1.00.

Aspects of the Firm Size Effect

The firm size phenomenon is remarkable in several ways. First, the greater risk of small stocks does not, in the context of the capital asset pricing model (CAPM), fully account for their higher returns over the long term. In the CAPM, only systematic or beta risk is rewarded; small company stocks have had returns in excess of those implied by their betas.

Second, the calendar annual return differences between small and large companies are serially correlated. This suggests that past annual returns may be of some value in predicting future annual returns. Such serial correlation, or autocorrelation, is practically unknown in the market for large stocks and in most other equity markets but is evident in the size premia.

Third, the firm size effect is seasonal. For example, small company stocks outperformed large company stocks in the month of January in a large majority of the years. Such predictability is surprising and suspicious in light of modern capital market theory. These three aspects of the firm size effect—long-term returns in excess of systematic risk, serial correlation, and seasonality—will be analyzed thoroughly in the following sections.

Long-Term Returns in Excess of Systematic Risk

The capital asset pricing model (CAPM) does not fully account for the higher returns of small company stocks. Table 5-5 shows the returns in excess of systematic risk over the past 74 years for each decile of the NYSE. Recall that the CAPM is expressed as follows:

$$k_s = r_f + (\beta_s \times ERP)$$

Table 5-5 uses the CAPM to estimate the return in excess of the riskless rate and compares this estimate to historical performance. According to the CAPM, the expected return on a security should consist of the riskless rate plus an additional return to compensate for the systematic risk of the security. The return in excess of the riskless rate is estimated in the context of the CAPM by multiplying the equity risk premium by β (beta). The equity risk premium is the return that compensates investors for taking on risk equal to the risk of the market as a whole (systematic risk).[2] Beta measures the extent to which a security or portfolio is exposed to systematic risk.[3] The beta of each decile indicates the degree to which the decile's return moves with that of the overall market.

[2] The equity risk premium is estimated by the 74-year arithmetic mean return on large company stocks, 13.3 percent, less the 74-year arithmetic mean income-return component of 20-year government bonds as the historical riskless rate, in this case 5.2 percent. (It is appropriate, however, to match the maturity, or duration, of the riskless asset with the investment horizon.) See Chapter 3 for more detail on equity risk premium estimation.

[3] Historical betas were calculated using a simple regression of the monthly portfolio (decile) total returns in excess of the 30-day U.S. Treasury bill total returns versus the S&P 500 total returns in excess of the 30-day U.S. Treasury bill, January 1926–December 1999. See Chapter 4 for more detail on beta estimation.

A beta greater than one indicates that the security or portfolio has greater systematic risk than the market; according to the CAPM equation, investors are compensated for taking on this additional risk. Yet, Table 5-5 illustrates that the smaller deciles have had returns that are not fully explainable by their higher betas. This return in excess of that predicted by CAPM increases as one moves from the largest companies in decile 1 to the smallest in decile 10. The excess return is especially pronounced for micro-cap stocks (deciles 9–10). This size-related phenomenon has prompted a revision to the CAPM, which includes a size premium. Chapter 1 presents this modified CAPM theory and its application in more detail.

This phenomenon can also be viewed graphically, as depicted in the Graph 5-2. The security market line is based on the pure CAPM without adjustment for the size premium. Based on the risk (or beta) of a security, the expected return lies on the security market line. However, the actual historic returns for the smaller deciles of the NYSE lie above the line, indicating that these deciles have had returns in excess of that which is appropriate for their systematic risk.

Table 5-5: Long-Term Returns in Excess of CAPM Estimation for Decile Portfolios of the NYSE (1926–1999)

Decile	Beta*	Arithmetic Mean Return	Realized Return in Excess of Riskless Rate**	Estimated Return in Excess of Riskless Rate†	Size Premium (Return in Excess of CAPM)
1-Largest	0.90	12.13%	6.93%	7.28%	–0.35%
2	1.04	13.55%	8.34%	8.36%	–0.02%
3	1.08	13.92%	8.71%	8.76%	–0.05%
4	1.12	14.55%	9.35%	9.07%	0.28%
5	1.15	15.28%	10.08%	9.31%	0.76%
6	1.18	15.60%	10.24%	9.49%	0.74%
7	1.23	15.44%	10.54%	9.90%	0.64%
8	1.27	16.80%	11.60%	10.22%	1.38%
9	1.33	17.59%	12.38%	10.77%	1.61%
10-Smallest	1.43	20.73%	15.52%	11.57%	3.95%
Mid-Cap, 3–5	1.11	14.35%	9.14%	8.95%	0.19%
Low-Cap, 6–8	1.21	15.81%	10.60%	9.77%	0.84%
Micro-Cap, 9–10	1.36	18.40%	13.19%	10.99%	2.21%

**Betas are estimated from monthly portfolio total returns in excess of the 30-day U.S. Treasury bill total return versus the S&P 500 total returns in excess of the 30-day U.S. Treasury bill, January 1926–December 1999.*

***Historical riskless rate is measured by the 74-year arithmetic mean income return component of 20-year government bonds (5.21 percent).*

† Calculated in the context of the CAPM by multiplying the equity risk premium by beta. The equity risk premium is estimated by the arithmetic mean total return of the S&P 500 (13.28 percent) minus the arithmetic mean income return component of 20-year government bonds (5.21 percent) from 1926–1999.

Graph 5-2: Security Market Line versus Size-Decile Portfolios of the NYSE (1926–1999)